PROGRAMMATIC ACTION: A programmatic action represents a physical, operational, legal, or institutional change or alternative means to achieve a target. The number of actions and their level of implementation is subject to adjustment by adaptive management. For example, the number of diversions screened may be adjusted up or down depending on the overall response of fish populations to screening and other restoration actions.

An example of a programmatic action is to develop a cooperative program to acquire and restore 1,500 acres of tidal perennial aquatic habitat in the Suisun Bay and Marsh Ecological Management Unit.

SPECIES DESIGNATION: The classification system used to organize species by status. The species designations used in the ERP for species evaluated in the MSCS are identical to the designations used in the MSCS (recover, contribute to recovery, and maintain), and include additional designations for species or biotic communities not addressed in the MSCS. The two additional ERP designation include enhance and/or conserve native biotic communities, and maintain and enhance harvestable species. The species designated for recovery, contribute to recovery, maintain and enhance and/or conserve native biotic are addressed by Strategic Goal 1. Species designated as maintain and enhance harvestable species are addressed by Strategic Goal 3 (maintain and/or enhance populations of selected species for sustainable commercial and recreational harvest consistent with other ERP strategic goals).

SPECIES GOAL: Goals recommended by the Multi-Species Conservation Strategy Team for evaluated species. The MSCS species goals include recover, contribute to recovery, and maintain. The analogous ERP terms are found in the Strategic Objective for Strategic Goal 1 which addresses at-risk species.

SPECIES GOAL PRESCRIPTIONS: A performance standard to measure progress toward the species goal by providing habitat or population targets. (Note: Species Goal Prescriptions originate from the MSCS. The ERP equivalent is species target. For species designated as recover, contribute to recovery, or maintain, the ERP species target is identical to the MSCS species goal prescription. For species not evaluated in the MSCS, the ERP species target is the performance standard to measure progress toward the objective.)

SPECIES AND SPECIES GROUPS: Certain species or groups of species are given particular attention in the ERP. This focus is based on four criteria that might be met by a species (including fish, wildlife, and plants): 1) it is a formally listed threatened or endangered species (e.g., winter-run chinook salmon, delta smelt), or it is a species proposed for listing; 2) it is economically important, supporting a sport or commercial fishery (e.g., striped bass, signal crayfish); 3) it is a native species or species community that is presently not listed by which could be if population abundance or distribution declines, or 4) it is an important prey species (e.g., Pacific herring).

STAGE 1 EXPECTATIONS: Stage 1 expectations are meant to be measures of the progress towards meeting short-term objectives in the first 7 years of implementation program. These expectations have two basic components: improvements in information to allow better management of the ecosystem and improvements in physical and biological properties of the Bay-Delta ecosystem and watershed.

STRATEGIC GOAL: Strategic goals are the broad statements that define the scope and purposes of the ERP. Strategic goals provide guidance in structuring Strategic Objectives, developing targets, and evaluating proposed restoration actions.

The hierarchy for goals, objectives, targets and programmatic actions follows:

- *Strategic Goal*
  - *Strategic Objective*
    - *Target*
      - *Programmatic Action.*

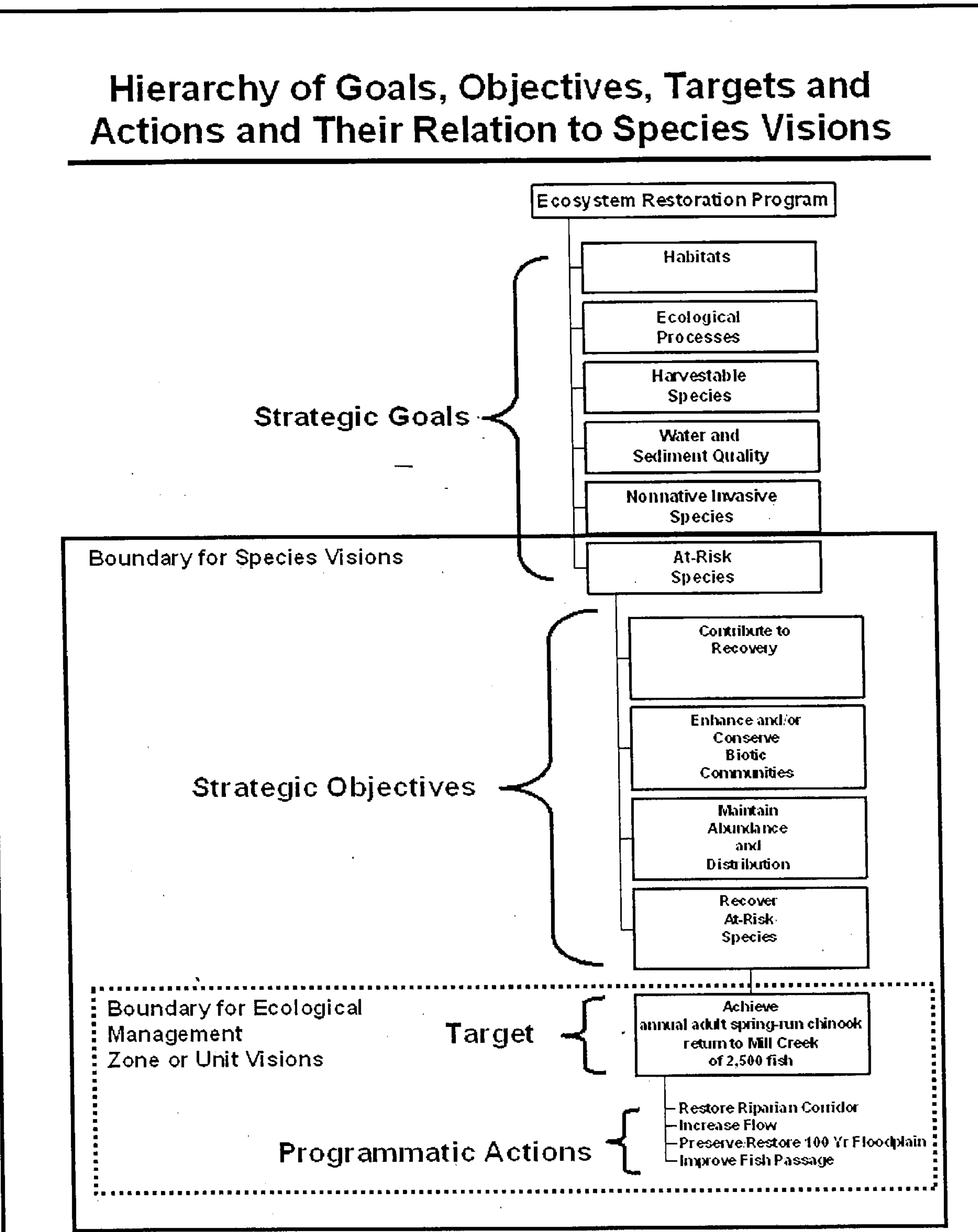


Figure 3. Relation of ERP visions. Visions in ERP Volume I are broad and encompass the entire ERP focus area. Visions in ERP Volume II are narrow and address needs within an Ecological Management Zone or Unit.

STRATEGIC OBJECTIVES: Strategic Objectives are associated with the Strategic Goals and areintended to assess progress toward achieving the associated goals. Strategic Objectives are fixed and are not expected to change over time. Strategic objectives are a more detailed delineation of the Strategic Goal components and provide a framework to develop and organize targets and programmatic actions. A strategic objective is the most specific and detailed description of what the ERP strives to maintain or achieve for an ecosystem element. The objectives are stated primarily in terms of management actions designed to have a favorable impact on the Bay-Delta system, however, some are also stated in terms of studies that will teach us how the ecosystem behaves so that principles of adaptive management can be better employed. (Note: Strategic Objectives differ from long- and short-term objectives.)

STRESSORS: Stressors are natural and unnatural events or activities that adversely affect ecosystem processes, habitats, and species. Environmental stressors include water diversions, water contaminants, levee confinement, stream channelization and bank armoring, mining and dredging in streams and estuaries, excessive harvest of fish and wildlife, introduced predator and competitor species, and invasive plants in aquatic and riparian zones. Some major stressors affecting the ecosystem are permanent features on the landscape, such as large dams and reservoirs that block transport of the natural supply of woody debris and sediment in rivers or alter unimpaired flows.

TARGET: A target is a qualitative or quantitative statement of a Strategic Objective. Targets are something to strive for but, unlike Strategic Objectives, may change over the life of the program with new information and progress, or may vary according to the configuration of storage and conveyance in all alternatives. Target adjustments will be science driven and based on the results of adaptive management. Targets may include a range of values or a narrative description of the proposed future value of an ecosystem element. Targets are to be set based upon realistic expectations, must be balanced against other resource needs and must be reasonable, affordable, cost effective, and practicably achievable.

The intent of the ERP is to achieve ecosystem health; targets are flexible tools to guide the effort. The level of implementation for each target will be determined or adjusted through adaptive management. Targets are categorized according to the three levels of certainty described above: (1) targets that have sufficient certainty of success to justify full implementation in accordance with program priorities and staged implementation; (2) targets which will be implemented in stages with the appropriate monitoring and evaluation to judge benefits and successes; and (3) targets for which additional research, demonstration and evaluations are needed to determine feasibility or ecosystem response.

Examples of targets include restoring 2,000 acres of tidal perennial aquatic habitat in the South Delta Ecological Management Unit (quantitative target) and reducing entrainment of juvenile salmon, steelhead, sturgeon, and splittail into water diversions to levels that will not impair stock rebuilding or species restoration (qualitative target).

VISION: A vision is what the ERP will accomplish with the stated objectives, targets, and programmatic actions for an ecological process, habitat, species or species group, stressor, or geographical unit. The vision statements included in the ERP provide technical background to increase understanding of the ecosystem and its elements. Two types of vision statements are included in the ERP: visions for ecosystem elements (landscape level visions in Volume I) and visions for ecological zones and units (ecological zone level visions in Volume II).

The broad landscape level resource visions address an individual ecological processes, habitat, species or species group, or stressor, while the ecological zone and unit visions address the integration of ecological processes, habitats, species, and stressors within a clearly delineated geographical area. Cumulatively, the visions also provide detailed descriptions of the ecosystem and its elements as they will look and function after restoration is accomplished.

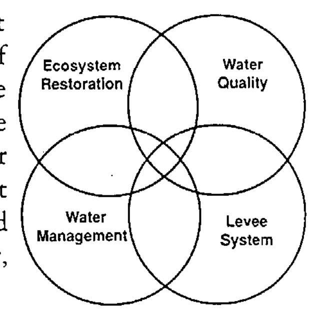
Table 1. Crosswalk of ERP and MSCS Terminology.

ERP Term	MSCS Term	Clarification
Strategic Goal	-----	The MSCS has no equivalent term for strategic goal.
Strategic Objective	Species Goal	The ERP has adopted the MSCS species goals for evaluated species (recover, contribute to recovery, and maintain) which are reflected in three of the objectives for at-risk species. The ERP has two additional species-oriented objectives that include enhancing and conserving biotic communities and maintaining and enhancing harvestable species.
Target	Species Goal Prescription	ERP species targets are analogous to the MSCS use of species goal prescriptions for evaluated species. The ERP includes targets for species not evaluated in the MSCS including biotic communities and harvestable species. The ERP terminology is "target" for processes, habitats, and stressors and "species target" for species to differentiate from the MSCS use of "species goal prescription" for evaluated species.
Programmatic Action	Conservation Measure	ERP programmatic actions and MSCS conservation measures are closely related but are not synonomous. Programmatic actions are physical, operational, or regulatory activities to improve ecological health while conservation measures provide guidance on the manner in which the programmatic actions are implemented. MSCS conservation measures also provide additional detail to some ERP programmatic actions.

Relationship of Other CALFED Common Programs to Ecosystem Restoration

Three fundamental concepts related to the Bay-Delta system and its problems have guided the development of proposed CALFED solutions. These concepts are not new, but CALFED has looked at them in new ways to develop options for solving problems successfully.

First, the four resource areas (ecosystem quality, water quality, water supply reliability, and levee system integrity) are interrelated. CALFED cannot effectively describe problems in one resource area without discussing the other problem areas. It follows that solutions will be interrelated as well; many past attempts to improve a single resource area have achieved limited success because solutions were too narrowly focused.



Second, there is great variation in the flow of water through the system and in the demand for that water at any time scale that might be examined (from year to year, between seasons, even on a daily basis within a single season). The value of water for all uses tends to vary according to its scarcity, quality, and timing. This leads to the need for a water management strategy.

Finally, the solutions must be guided by adaptive management. The Bay-Delta system is exceedingly complex, and it is subject to constant change as a result of factors as diverse as global warming and the introduction of exotic species. CALFED will need to adaptively manage the system as we learn from our actions and as conditions change.

INTERRELATIONSHIPS

In the past, most efforts to improve water supply reliability or water quality, improve ecosystem health, or maintain and improve Delta levees were single-purpose projects. A single purpose can keep the scope of a project manageable but may ultimately make the project more difficult to implement. The difficulty occurs because a project with narrow scope may help to solve a single problem but have impacts on other resources, causing other problems. This in turn leads to conflict. Ultimately, either no problem is solved, or one problem is solved while others are created.

The CALFED Program takes a different approach, recognizing that many of the problems in the Bay-Delta system are interrelated. Problems in any one problem area cannot be solved effectively without addressing problems in all four areas at once. This greatly increases the scope of our efforts but will ultimately enable us to make progress and move forward to a lasting solution.

Thus, the most important single difference between the CALFED Bay-Delta Program and past efforts to solve resource problems is the comprehensive nature of CALFED's interrelated resource management strategies. A comprehensive CALFED solution will also be supported by governance and finance mechanisms that overcome problem-specific or resource-specific limitations of previous, more narrowly focused, approaches.

Significantly, there are many linkages among the objectives in the four problem areas and among the actions that might be taken to achieve these objectives. Solving problems in four areas at once does not require a four-fold increase in the cost or number of actions. Most actions that are taken to meet program objectives, if carefully developed and implemented, will make simultaneous improvements in two, three, or even four problem areas.

Eight Program Elements Working Together to Solve the Four Problem Areas

- Long-Term Levee Protection Plan
- Water Quality Program
- Ecosystem Restoration Program
- Water Use Efficiency Program
- Water Transfer Program
- Watershed Program
- Storage
- Conveyance

What kinds of actions can be taken to solve problems in the Bay-Delta system? The actions can be grouped into categories of levee system improvements, water quality improvements, ecosystem restoration, water use efficiency, water transfers, watershed management, water storage, and Delta conveyance modifications. Specific actions range from physical restoration of habitat in the Delta to water conservation measures.

While CALFED generally does not expect to rely on new regulations to implement Program objectives, it does recognize that existing regulatory programs will continue to be implemented by CALFED agencies. CALFED represents a unique opportunity to provide high-level coordination of these regulatory programs so that regulatory implementation works in furtherance of CALFED Program goals. The CALFED Bay-Delta Program specifically defines incentives and voluntary partnerships to implement many individual actions in the Program. Incentives allow stakeholders to participate in CALFED actions which may not have been economical to them without the incentives. Partnerships allow stakeholders and CALFED agencies to leverage their individual resources by teaming together to implement certain actions.

Some regulations, like those contained in the State and federal Endangered Species Acts (ESA) and Section 404 of the Clean Water Act, are ones that CALFED must satisfy as the Program is implemented. Many other regulatory actions can be made more effective and constructive as a result of CALFED actions. For example, water quality regulatory agencies are obligated to develop total maximum daily loads (TMDLs) for certain water quality constituents in the Bay-Delta system. CALFED efforts in monitoring and research will provide valuable information which will assist regulatory agencies in developing these TMDLs. CALFED incentive-based source control actions will help reduce the load of these and other pollutants. In this way, the CALFED Bay-Delta Program will help in meeting many ongoing regulatory requirements.

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◆ Key Ecological Attributes of the San Francisco Bay-Delta Watershed

Note: The following section is a summary of information provided by the Indicators Workgroup (1998).

RATIONALE

Understanding the structure, function and organization of ecosystems is necessary for planning and implementing environmental restoration, rehabilitation and protection projects. Such understanding enables managers to assess, during planning phases of a program, the degree to which prospective restoration sites diverge from a "healthy" or "natural" condition, as well as to evaluate, after actions have been undertaken, project progress and effectiveness. In a management context, perhaps the most practical means of summarizing the most relevant existing information on ecosystems is to develop, over an appropriate hierarchy of spatial and ecological scales, a list of key system attributes - those fundamental natural ecological characteristics that together define and distinguish these systems, their status, and/or their interrelationships. Such lists of attributes may serve as a convenient and necessary "check list" of environmental factors that might be addressed in an ecological restoration/rehabilitation context. At sites for which comprehensive restoration is the goal, a full suite of applicable attributes would presumably be addressed. More commonly, at sites where partial restoration (rehabilitation) is the goal, actions and efforts would be focused upon an appropriate subset of attributes.

Some individual system attributes - such as water temperature - may be evaluated directly. Others, such as "habitat continuity," are more nebulous, and must be evaluated by developing appropriate "indicators" - measurable parameters that provide a means to objectively (preferably quantitatively) evaluate individual attributes that in themselves are not readily measured. The term indicator is also used in a broader context to refer to a *subset* of system attributes (or their measurable parameters) that are derived and used *as a group* to provide a convenient way to evaluate *overall* system status. Thus, the term "indicator" is commonly used in two somewhat different ecosystem management/restoration contexts, representing two differing scales of resolution: that of *individual* attributes, or alternately, that of *groups* of attributes. In either case, "indicators" are simply a convenient way of measuring or evaluating that which is of primary concern - system attributes. An additional, and most useful tool in understanding and describing fundamental characteristics of complex systems is the use of conceptual models that integrate and diagrammatically represent the three basic *kinds* of system components: elements (attributes), their states, and the relationships that affect attribute states.

This document presents a provisional list of natural ecological attributes and indicators of the ecosystems of this watershed for use in the context summarized above.

ECOSYSTEM TYPOLOGY

The ERP study area is divided into four ecological zones, based on similarities and differences in their respective attributes. The ecological zone designations follow:

- Upland River-Floodplain Ecological Zone
- Alluvial River-Floodplain Ecological Zone
- Delta Ecological Zone
- Greater San Francisco Bay Ecological Zone

Tables 2-5 display the attributes and indicators related to each ecological zone which were developed by the Indicators Workgroup. Table 6 offers an alternative view of the ecological attributes of alluvial river ecosystem (McBain and Trush 1999).

Table 2: Ecological Zone: Upland River-Floodplain Ecosystem.		
Ecosystem Geographic Scope: Upland river-floodplain ecosystems are defined as rivers, streams, and associated riparian corridors that extend from headwaters elevations in the Coast Ranges, Cascade Range, and Sierra Nevada to the point near the floor of the Central Valley where they merge with alluvial river-floodplain ecosystems (in most cases near the 300 foot (91.4 m) elevation contour). The Sacramento River above Red Bluff is included in the upland river-riparian ecosystem. Most rivers and streams in this ecosystem correspond with the A2410 (fishless low-order tributaries) to A2430 (salmon-steelhead streams) series in the habitat classification system of Moyle and Ellison (1991) and Moyle (1996).		
INDICATOR TYPE	**ATTRIBUTE**	**INDICATORS**
Hydrologic/ Hydrodynamic	Variable streamflows	■ Minimum base flows ■ Seasonal shifts in stream level ■ Measures of variability
	Floods	■ Minimum surface area of floodplain inundated at least once every 2 years ■ Flood duration (mean and variability)
	Ground water	■ Depth of water table ■ Soil moisture levels, laterally from banks. ■ Characteristic plant communities ■ Width of riparian corridor
Geomorphic	Dynamic Channels	■ Bedload movement ■ Sediment particle size and distribution ■ Pool-to-riffle ratio ■ Inter-annual comparison of fluvial geomorphic features
	Sediment budget	■ Net change in depth per unit time of unconsolidated sediment
Habitat	Habitat mosaic and connectivity	■ Extent and distribution of patches of all natural habitat types ■ Presence and distribution of species requiring multiple habitats ■ Presence and distribution of native and migratory fish species ■ Length of river channel obstructed by artificial barriers ■ Length of riparian corridor unobstructed by artificial barriers
	Water/sediment quality	■ Toxicity -- concentrations in water and sediment -- tissue concentrations -- bioassays -- biomarkers -- bioindicators -- contaminant loading ■ Dissolved oxygen ■ Turbidity-suspended solids ■ Temperature ■ Nutrients (N, P, C)
	Instream habitat complexity	■ Pool-to-riffle ratio ■ Abundance, distribution, and recruitment rate of large woody debris ■ Shaded riverine aquatic habitat ■ Diversity of flow velocity

Table 2: Ecological Zone: Upland River-Floodplain Ecosystem.		
Biological Communities	Community Structure	■ Trends in the abundance, diversity, composition, and distribution of riparian insect assemblages, by functional group ■ Trends in the abundance, diversity, composition, and distribution of benthic invertebrate assemblages, by functional group ■ Trends in abundance, reproductive success, diversity, composition, and distribution of native resident and migratory birds ■ Trends in the abundance, diversity, composition, and distribution of native mammals ■ Trends in distribution, diversity, and structural complexity of native plant associations ■ Trends in abundance, diversity, composition, distribution and trophic structure of natives fishes ■ Invasive introduced species -- measures of new invasions -- abundance, spatial extent and distribution of selected species -- number of selected species eradicated or exhibiting no net increase in distribution ■ Population trends of selected listed species ■ Fish and wildlife health
Community Energetics/ Nutrient Cycling	Nutrient loading	■ Nutrients from salmon carcasses ■ Organic input from grazing animals ■ Ratios of natural to anthropogenic sources of nutrients

Table 3: Ecological Zone: Alluvial River-Floodplain Ecosystem.		
Ecosystem Geographic Scope: Lowland rivers, as defined herein, constitute those waterways and their floodplains that traverse the alluvial deposits of the Central Valley. The actual geomorphic "dividing line" between "upland" and "lowland" river-floodplain systems (as defined in this document) generally occurs at about the 300 ft. elevation contour. Lowland river-floodplain systems of the Central Valley are distributed across a vast area, covering thousands of square miles. This does not include the Redding Basin, which is considered part of the upland mountain river-floodplain ecosystem described in the previous section.		
INDICATOR TYPE	**ATTRIBUTE**	**INDICATORS**
Hydrologic/ Hydrodynamic	Variable streamflows	■ Minimum base flows ■ Seasonal shifts in river level ■ Measures of variability ■ Geographic distribution of flows
	Floods	■ Minimum surface area of floodplain inundated at least once every 2 years and every 10 years ■ Flood duration (mean and variability) ■ Mean annual frequency
	Ground water	■ Depth of water table ■ Soil moisture levels, laterally from banks. ■ Characteristic plant communities ■ Width of riparian corridor
Geomorphic	Topography	■ Mean width of available meander corridor ■ Percent of river length not constrained by constructed levees ■ Distribution and extent of floodplain habitats ■ Distribution and extent of littoral zone
	River meander	■ Percent of river miles exhibiting naturalistic meandering
	Sediment supply, delivery, and movement processes	■ Net change in depth per unit time of unconsolidated sediment ■ Amount of coarse sediment delivered (as a proportion of pre-dam) ■ Lateral exchange: river to floodplain ■ Inter-annual comparison of fluvial geomorphic features ■ Sediment particle size and distribution ■ Pool-to-riffle ratio
Habitat	Habitat mosaic and connectivity	■ Extent and distribution of patches of all natural habitat types ■ presence and distribution of species requiring multiple habitats ■ Presence and distribution of migratory fish species ■ Number of unnatural barriers interfering with natural movements of native species, water flow, sediment transport and supply, and nutrient transport